

WHAT IS CLAIMED IS:

- 1 1. A nanostructured apparatus, comprising:
2 a mesoporous template having a network of regularly-spaced pores, wherein a
3 characteristic dimension of the pores is between about 1 nm and about 100 nm; and
4 a layer of material that substantially coats one or more walls of the pores to a substantially
5 uniform thickness.
- 1 2. The apparatus of claim 1 wherein the pores include one or more sets of substantially
2 straight and parallel pores.
- 1 3. The apparatus of claim 2 wherein the pores include first and second sets of substantially
2 straight and parallel intersecting pores, wherein the pores in the first set run substantially
3 perpendicular to the pores in the second set.
- 1 4. The apparatus of claim 3 wherein the layer of material coats the walls of the pores in both
2 sets in a substantially uniform fashion.
- 1 5. The apparatus of claim 3 further comprising a third set of substantially straight and
2 parallel pores that intersect the pores in the first and/or second sets, wherein the pores in
3 the third set run substantially perpendicular to the pores in the first and second sets.
- 1 6. The apparatus of claim 5 wherein the layer of material coats the walls of the pores in all
2 three sets in a substantially uniform fashion.
- 1 7. The apparatus of claim 1 wherein the material is a first semiconductor material.
- 1 8. The apparatus of claim 1, further comprising a second semiconductor material disposed
2 within one or more of the pores, wherein the first and second semiconductor materials
3 have complementary charge transfer properties.
- 1 9. The apparatus of claim 1, wherein the mesoporous template is made from an insulating
2 material.
- 1 10. The apparatus of claim 9 wherein the insulating material is silica (SiO₂).
- 1 11. The apparatus of claim 1 wherein the mesoporous template is made from a
2 semiconducting material.

- 1 12. The apparatus of claim 1 wherein the layer of material includes one or more reactant
2 materials, catalyst materials, light absorbing materials or semiconducting materials.
- 1 13. The apparatus of claim 12 wherein the layer of material includes a first semiconducting
2 material.
- 1 14. The apparatus of claim 13 further comprising a second semiconductor material disposed
2 on the first semiconductor material, wherein the first and second semiconductor materials
3 have complementary charge transfer properties.
- 1 15. The apparatus of claim 14 wherein at least one of the first and second semiconductor
2 materials is a light absorbing material.
- 1 16. The apparatus of claim 14 wherein one of the first and second semiconductor materials is
2 an organic material.
- 1 17. The apparatus of claim 1 wherein the layer of material has been deposited by atomic layer
2 deposition.
- 1 18. The apparatus of claim 1 wherein the layer of material includes a light-absorbing
2 semiconductor material.
- 1 19. The apparatus of claim 1 wherein the layer of material includes a non-reactive metal or
2 metal oxide, that provides an inert surface whereby that apparatus may act as a filter.
- 1 20. The apparatus of claim 1 wherein the layer of material includes a reactive metal or metal
2 oxide that provides an inert surface whereby the apparatus may act as a catalyst and/or
3 filter.
- 1 21. The apparatus of claim 1 wherein the layer material has optical transmission, reflection,
2 absorption or other properties whereby the apparatus may act as an optical device.
- 1 22. The apparatus of claim 21 wherein the optical device is a luminescent, electro-optic, and
2 magneto-optic waveguides, optical filters, optical switches, amplifies, laser diodes,
3 multiplexers, optical couplers.
- 1 23. The apparatus of claim 1 wherein the layer of material includes a semiconducting or
2 conducting surface coating that can transmit electrical signals arising from binding of a
3 molecule to the surface coating, whereby the apparatus is a sensor.

- 1 24. An optoelectronic device, comprising:
2 an active layer disposed between a first electrode and a second electrode, wherein the
3 active layer includes a mesoporous template having a network of regularly-spaced pores,
4 wherein a characteristic dimension of the pores is between about 1 nm and about 100 nm;
5 and one or more semiconducting materials that substantially coat one or more interior
6 walls of the pores to a substantially uniform thickness.
- 1 25. The device of claim 24 wherein the mesoporous template is made of silica
- 1 26. The device of claim 25 wherein the first semiconducting material has been deposited by
2 atomic layer deposition.
- 1 27. The device of claim 26, wherein the one or more semiconducting materials include a first
2 semiconducting material and a second semiconducting material, wherein the first and
3 second semiconducting materials have complementary charge transfer properties.
- 1 28. The device of claim 24 wherein the semiconducting material is configured such that the
2 device is an LED, laser, or photovoltaic device.
- 1 29. A method for making a nanostructured apparatus, comprising:
2 forming a mesoporous template having a network of regularly-spaced pores, wherein a
3 characteristic dimension of the pores is between about 1 nm and about 100 nm; and
4 an active material coating one or more interior walls of the pores;
5 substantially coating one or more walls of the pores with an active material to a
6 substantially uniform thickness.
- 1 30. The method of claim 29 wherein forming a mesoporous template includes
2 disposing a sol on a substrate, wherein the sol includes one or more alkoxides with a
3 central element X, one or more surfactants, one or more condensation inhibitors, water,
4 and a solvent,
5 evaporating the solvent from the sol to form a surfactant-templated porous film, and
6 crosslinking the surfactant-templated porous film to form mesoporous template.
- 1 31. The method of claim 29 wherein coating one or more walls of the pores with an active
2 material includes depositing the active material by atomic layer deposition.